INJURY SCIENCE RESEARCH

TWENTY-EIGHTH INTERNATIONAL WORKSHOP

November 2000 Atlanta, Georgia

Editor

Faris A. Bandak, Ph.D.

INJURY SCIENCE RESEARCH

TWENTY-EIGHTH INTERNATIONAL WORKSHOP

November 2000 Atlanta, Georgia

Editor Faris A. Bandak, Ph.D.

U.S. Department of Transportation John A. Volpe National Transportation Systems Center Cambridge, Massachusetts

Preface

INJURY SCIENCE encompasses a broad range of disciplines beyond those in the natural sciences. Research in this field has direct implications on daily life, generating knowledge that contributes to the prevention, treatment, and rehabilitation of injury. Injury Science also deals with areas such as the social and economic effects of injury on the individual and on society as a whole. The Twenty-Eighth International Workshop on Human Subject Biomechanics addressed a range of subjects, in Injury Science research, presented in 16 chapters involving component and system levels of the human body. The contributions range from areas of research in injury response of the human brain resulting from shear deformation to advancements in the understanding of eye and ear injuries. Physical devices for the study of close-proximity air bag injuries, for material testing of bone, and for the detection of bone fracture were also advanced as parts of studies conducted to better understand injury mechanisms. Research on the injury of the cervical spine for both adults and children was presented along with research on child dummy neck loading response under different child restraint system environments. Contributions also include computational models for the development of the advanced Thor dummy and the inverse-dynamic assessment of dummy response during crash tests. The proceedings of this workshop are documented here in 16 submitted papers that have not been peer reviewed with the responsibility of submittal for peer review left to the individual authors.

> Faris A. Bandak, Ph.D. Cambridge, MA

Acknowledgements

The Twenty-Eighth International Workshop was successfully held as a result of the contributions of all the participants, including the authors and presenters. Special thanks are extended to the session chairs: Dr. Farid Bendjallal, Dr. Jeff Crandall, Dr. George Mouchahoir, Dr. Barry Myers, and Dr. Steve Rouhana. Special thanks are also extended to the NHTSA staff; the Volpe National Transportation Systems Center staff; T. Nguyen, Workshop Administrator Planner; Wendy Barhydt, Society of Automotive Engineers Meeting Planner; and Leda Ricci, Executive Director of the Stapp Crash Conference Advisory Committee, for their assistance in the preparation and conduct of the Workshop.

Many thanks are also extended to the authors and presenters for their contributions that made this workshop a very useful and beneficial experience for all the participants.

Faris A. Bandak, Ph.D. Chair

Contents

Prefacei
Acknowledgements
Contentsv
Nonlinear Viscoelastic Behavior of Brain Tissue in Oscillatory Shear Deformation
The Porcine Eye as a Surrogate Model for the Human Eye: Anatomical and Mechanical Relationships
A Method for the Study of Close-Proximity Occupant-Air Bag Interactions
Understanding and Minimizing Error in Cervical Spine Tensile Testing
Tensile Mechanics of the Developing Baboon Cervical Spine
Assessment of Auditory Hazard Resulting from Air Bag Deployment Noise
Dynamic Crack Detection in the Human Tibia Using Acoustic Emission
Effects of Lateral Impact on the Mechanical Properties of the Pubic Symphysis and Sacroiliac Joints
Characterization of Deformable Materials in the THOR Dummy

Head/Neck Rotation during +Gz Impact Acceleration	159
Mechanical Testing of Bone with Non-Standard Techniques E.C. ELEFTHERIOU	171
Analysis of Air Bag Loads by Inverse Dynamics	181
Child Dummy Neck Loading During Frontal Impact Crash Tests for Child Restraints Installed With and Without Top-Tether Anchorage Systems M. LLOYD, G. WILSON, D. ROBERTS, B. DONNELLY, A.C. BITTNER, JR.	201
Velocity and Level Dependent Facet Joint Kinematics in Low-Speed Rear Impact B.D. STEMPER, N. YOGANANDAN, F.A. PINTAR	213
Injuries of Abdominal Organs	219
Instrumentation of the Cervical Spine by Fixing Sensors on the Anterior Part of the Vertebrae	223
Contributors	229